could be stopped at either end at desired points so that the distance moved over could be conveniently and accurately read off. By aid of certain appliances the apparatus was serviceable for the methods of right and wrong cases and of the average error. There was also used a combination of the method of right and wrong cases, and of the just observable difference, which has nothing in its favor and its complexity against it. At other points the author is too much dominated by methods hardly applicable to the variable character of his results. The movements varied from 1 to 20 cm., and were made with the shoulder joint as a pivot, moving through an angle of from about 2° to 40°. Falk studied the effect of the rate of movement and the weighting of the carriage upon the constant and the variable errors. The attempt to reproduce distances of 1 cm. resulted in an exaggeration of 81% of 25 cm., 33% of 5 cm., 12.4% of 10 cm., an underestimation of 0.45%; and of 20 cm., 0.82%. The movements forward or away from the body are somewhat more accurate than movements backward or toward the body. Weighting the carriage with from 100 to 600 grms. does not appreciably affect the constant error. Passing to the variable error the measure of sensibility is not constant; when expressed by $\frac{1}{12}$ for 1 cm., it is $\frac{1}{19}$ for 2.5 cm., $\frac{1}{36}$ for 5 cm., $\frac{1}{47}$ for 10 cm., and $\frac{1}{57}$ for 20 cm.; the smaller movements showing the least sensibility. Movements forward show rather finer sensibility than movements backward. The rate of movement has only a slight effect upon the percentage of right judgments, that of 6 per minute having a slight advantage. The effect of weighting the carriage is also insignificant. Weber's law does not hold within the distances measured. The curve of movement as recorded on a drum and shown to gain slowly, reach a period of constancy and maximum rate, and again fall off.

BONNIER, *Physiologie du nerf de l'espace*, Comptes rend. 1891 CXIII. 566.

An acoustic disturbance coming from a given direction arrives at the ear under a certain angle of incidence, is reflected by the concha and the walls of the meatus externus and reaches the tympanum under a new angle of incidence which for a given end depends on the original angle. The concave and conical tympanum is driven back in the axis of its cone, if the noise arrives in that direction, and oscillates sidewise if the sound arrives in an oblique direction, drawing after it the point of the hammer. The system of the anvil and hammer forms a bent lever suspended on an axis that, thanks to the articulation of the joint, itself bends in the form of an elbow, and can turn in any direction. On both sides of this articulation there are three pivots, two for the hammer and one for the anvil. The external process of the hammer serves as pivot for the lateral downward oscillations of the hammer and as axis for the backward oscillations. The short process serves, above all, as axis for the movements from without inward, and as pivot for oscillations in any direction. The superior posterior process of the anvil serves as its pivot for all movements of bending in the central articulation and as axis for the direct oscillatory movements of the entire system. The articulation permits motion in every direction while yet retaining the total oscillation from without inward. According to the lateral oscillation of the point of the hammer, the system bends so that the surfaces of articulation quit each other at some points to meet at others, in such a manner that the angle formed by the two free arms varies in planes equally variable. The point of the anvil transmits by a double articulation its oscillations to the head of the stirrup, which in its turn oscillates around its tendinous insertion, pushing the base of the fenestra ovalis according to its various inclinations, which are the reverse of those of the point of the anvil, but always without disturbing the backward compression. According to its obliquity the plate of the stirrup

in forcing itself into the opening tends to depress such or such a pole of the adjacent utricular convexity. According to this compression, and according to the pole depressed, a circulation of the endolymph is caused in the utricule. This provokes corresponding currents in the semi-circular canals. These compensating currents vary in direction and intensity, depending on the direction of the displacement in the utricule, the pole depressed and the direction of incidence of the disturbance. The cristæ of the ampullæ perceive on opposite sides the direction and the intensity of these currents, which reconstitute in a manner the geometric description of the utricular disturbance. The nerve of the flat macula perceives the intensity of the disturbance which arrives diametrically from the convex wall, while the three nerves of the ampullæ analyze its direction. The so-called nerve of space is then only the nerve of disturbed space and of sonorous space. It defines the position of the points perceptible by the ear by means of the disturbance of the interposed medium. It localizes objectively the origin of auricular perceptions by the direction of the incidence of the disturbances.

E. W. SCRIPTURE.

SCHUMANN, *Ueber die Unterschiedsempfindlichkeit für kleine Zeitgrössen*, Zeitschrift für Psychologie und Physiologie der Sinnesorgane, 1891 II. 294.

The experiments were performed by the methods of right and wrong cases and the average errors. The clicks which gave the time interval were produced by the momentary passage of a current in a telephone. The closing of the current was done by contact with platinum points on a regularly revolving wheel. Time intervals from 0.15 sec. to 2 sec. were experimented upon by the method of right and wrong cases. The discriminative sensibility was found to be greatest for 0.3 to 0.4 of a second, a result in agreement with that of Mach. By the method of average errors experiments were tried upon intervals from 0.5 to 5 sec. This method, however, cannot be employed for solving this problem, because the average error is very great with intervals between 0.3 and 0.4 seconds, whereas, the discriminative sensibility was found to be finest at this point by the method of right and wrong cases. Moreover, comparison and reproduction of small time intervals are different operations. BERGSTRÖM.

EPSTEIN, *Die logischen Principien der Zeitmessung*, Leipzig, 1887.

The author reviews the opinions of Newton, Locke and Leibnitz; and at the end of his article some of the recent mathematical definitions of equal times. He approaches the problem from the side of the theory of knowledge. Time is an auxiliary variable introduced by us into the phenomenal world to give order to its events or processes. Equal times are those in which identical events take place. But we have no criterion of identical events and must content ourselves with considering those events identical for which the contrary hypothesis would be less reasonable. BERGSTRÖM.

METTLER, *Aural vertigo (Menière's Disease)*. Journ. Nerv. Ment. Dis. 1891 XVI. 19.

There is no sufficient reason for supposing that the semi-circular canals or any other definite organs are the seat of the sense of equilibrium. The feeling of equilibrium is due to the harmonious relations of the sensory centers to each other and to the motor centers connected with them. Any serious injury to the centers may bring about the mental confusion and motor ataxy which we call vertigo. BERGSTRÖM.